

CONTEXT EFFECTS ON CHILDREN'S INTERPRETATION AND  
GENERALIZATION OF NOVEL ACTION VERBS

By

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Two studies examined how children and adults learn and subsequently extend new verbs to appropriate contexts. Experiment 1 demonstrated the importance adults accord manner, outcome, instrument, and agent in their initial interpretation of action verb meaning. Adults were first taught verbs using novel videotaped action events. Next, subjects were asked whether these verbs labeled other action events in which only the agent, instrument, manner, or outcome had been changed. Almost invariably, adults considered the outcome and manner changes more important in their initial interpretation of the novel events. Two further issues were of particular interest in Experiment 2. The first concerned whether children's initial assumptions about the meaning of the same verbs undergo developmental change. The second was whether children's and adults'

biased interpretations are affected by differences between the kinds of initial events from which novel action verbs are learned. When the initial training consisted of three nearly identical events, subjects were least likely to extend the novel verbs. When the initial training consisted of viewing three events in which a single event component varied, subjects were most likely to extend the novel verb. When the initial training consisted of viewing events in which only one component was held constant while the others varied, subjects' made an intermediate number of extensions. Most strikingly, the combined effects of initial training and event component varied according to subjects' age. Unlike adults and 10-year-olds, 3-year-olds' biased interpretations of novel action verbs can actually be changed by different types of initial verb learning experiences. Taken together, the studies show that 3-year-olds' action verb concept differs in a principled way from that of 10-year-olds and adults. Results are further interpreted in terms of verb learning biases and developing action verb concepts.

CHAPTER 1  
CONTEXT EFFECTS ON CHILDREN'S INTERPRETATION AND  
GENERALIZATION OF NOVEL ACTION VERBS

Manifestly, the task of explaining how children learn words is a daunting complex endeavor. A persistent response to this complexity in many theories of lexical acquisition is to assume that children benefit from a set of language-specific constraints without which, the task would be impossible (e.g., Markman, 1991; Nagy & Gentner, 1990). In general, constraint theorists tend to focus almost exclusively on characteristics of language learners to the exclusion of the larger context in which learning a language occurs. However, other researchers have shown that the social-pragmatic context is an essential source of information which guides children's lexical acquisition (Nelson, 1988; Tomasello, 1992b). Thus adults' ability to interpret children's focus of attention, shared experience of past and ongoing events, or even properties of the language input have been proposed as important determinants of children's acquisition of word meaning (Behrend & Harris, 1991; Bowerman, 1982; Nelson, 1985; Tomasello & Farrar, 1986).

The premise of my research is that verb acquisition and generalization is not entirely explicable in terms of what verb learners already know (i.e., constraints), nor



altogether in terms of the context within which verbs are modeled. Rather, a more complete explanation of verb acquisition and extension lies in understanding how these and other factors interact. Of interest from both studies reported in this dissertation was whether children and adults are biased to interpret some components of action verb meaning as more central to their initial representations. Of particular interest from the second study was how differences in the kinds of initial exemplars from which verbs are learned affect children's and adults' initial interpretation and generalization of novel action verbs.

#### Perspectives on Lexical Acquisition Constraints

Debate over the precise nature of constraints on word acquisition has produced a number of perspectives about how constraints should be depicted (e.g., Clark, 1987; Gallistel, Brown, Carey, Gelman & Keil, 1991; Markman, 1991; Tomasello, 1992b). Part of the disagreement is attributable to the difficulty in explaining the specific mechanisms by which constraints operate, what exactly it is that they do (Nelson, 1988), when and how they arise (Merriman & Bowman, 1989), or even when they diminish (Forbes & Farrar, in press). One way to analyze lexical constraints is to select a single dimension along which they can be examined. One such dimension, heretofore receiving

little explicit treatment, is the restrictive-enabling dimension.

The restrictive-enabling distinction is nonetheless crucial because it determines many theoretical assumptions concerning constraints, which hypotheses get tested, and the research methodologies brought to bear on these questions. Arguments for restrictive constraints tend to emphasize the indefinite number of hypotheses children could make about the meaning of novel words (e.g., Quine, 1960; Golinkoff, Mervis, & Hirsh-Pasek 1992; Markman, 1991). Consequently, constraints restricting the number of hypotheses children could entertain about the meaning of novel words are viewed as essential for word learning to occur. Restrictive constraints tend also to emphasize innate, language-specific content knowledge. Arguments for enabling constraints, on the other hand, tend to emphasize strategies acquired during the course of language learning that help children learn the ways in which a given language organizes semantic meaning (e.g., Bowerman, 1985; Gallistel, Brown, Carey, Gelman, & Keil, 1991). The enabling constraints view stresses procedural knowledge and strategies adopted by word learners which allow them to pick up the semantic distinctions specific to their language. Rather than a bimodal distribution, the restrictive-enabling constraint distinction is probably more normally distributed. Most proposed lexical acquisition constraints have restricting

and enabling elements, while others can be characterized almost entirely by one pole or the other.

My studies examine how the restrictive-enabling distinction applies to verb acquisition. They do so by first establishing whether children and adults are biased to favor some elements of verb meaning over others. Biased verb interpretations would constitute support for either a restrictive or enabling constraints position. This is because biases could reflect the operation of innate language specific constraints or the structure and context of verb learning situations. Next, the studies examine whether biases can be attenuated or even changed by different types of verb learning experiences. Also, adults' and young children's interpretations of novel verb meaning are directly compared to determine whether biases change developmentally. The extent to which biased interpretations can not be altered by the verb learning situation and show no developmental changes would be consistent with a restrictive constraints explanation. The extent to which biased interpretations can be altered by the verb learning situation and do show developmental changes would be consistent with an enabling constraints explanation.

At this point, a more thorough review of the research used to support restrictive and enabling constraints explanations of lexical acquisition is in order.

### Lexical Acquisition Research Based on the Restrictive Constraints View

One example of where research based on a restricting constraints view leads can be seen in Markman's (1991) account of lexical acquisition. According to Markman, lexical acquisition by very young children is made possible by constraints restricting the kinds of hypotheses they could otherwise make about the meaning of novel words. For example, young children have a well known tendency to categorize nonlinguistic concepts on the basis of thematic relations (e.g., banana-monkey) (Nelson, 1977; Tversky, B., & Hemenway, K., 1984). Clearly, young children will be more successful in correctly generalizing novel object labels such as "fruit" if they do so on the basis of category membership based on perceptual and functional similarity-- taxonomic relations (e.g., banana-grapes). A important aspect of lexical acquisition is learning to extend words to objects, events, and concepts similar to those with which the word was originally modeled. In fact, Markman and Hutchinson (1984) claim that the "taxonomic assumption" allows children to override their tendency to categorize using thematic relations. That is, children seek to extend a novel object word on the basis of taxonomic rather than thematic relations. It is the presence of a novel object label, Markman and Hutchinson argue, that compels children to make taxonomic assumptions. In this way young children

avoid many fruitless hypotheses about what a new word might mean. Similarly, Markman's whole object constraint leads children to assume that a novel label refers to a whole object rather than to some specific attribute of the object. Rather than entertaining an indefinite number of potentially inappropriate hypotheses about the meaning of a novel object label, children's default assumption is that the label refers to the whole referent rather than to one of its properties.

Markman's (1991) insistence on the necessity of restricting constraints such as the taxonomic assumption and the whole object constraint is motivated by her acceptance of the Quinian conundrum depiction of word learning. Quine (1960) depicted the task of learning a novel word as a logical induction problem. Quine's formulation of this logical problem of induction is given in terms of an adult linguist in a foreign land trying to determine that gavagai means rabbit when uttered by a native speaker as a rabbit runs by. Logically, rabbit could refer to the color of the animal's fur, any animal with four legs, long ears, the animal's position at the moment of uttering gavagai, and so on indefinitely. Extrapolating from this extensively cited and influential adult example, Markman (1991) claims constraints (e.g., taxonomic assumption, whole object) spare children the time consuming task of eliminating many possible hypotheses of novel word meaning.

There are of course many instances where children would be misled by a taxonomic or whole object constraint. When, for example, a child hears a novel term applied to an object for which she already knows the name, a whole object constraint would apparently overrestrict the number of hypotheses to consider. Ostensibly, the immediate result would be that the child would fail to learn the novel term or even become confused about the meaning of the known label. Not so argues Markman. In this situation another constraint, mutual exclusivity (ME), helps children override the whole object assumption. Mutual exclusivity is necessary in Markman's scheme of things to account for how children do eventually learn the names of object parts, properties, or attributes.

Still, children must override mutual exclusivity itself in at least two circumstances. One is when a novel label is clearly part of a hierarchy of labels for a given object. Children must override ME to accept the label "animal" for creatures known to them as "dogs." Another is when labels from different languages are used for the same object. Very early on, children bilingual in English and Spanish must accept the term perro for animals known to them as dogs. This they are able to do once they have acquired about 150 productive words in both languages (Markman, 1991). Therefore, Markman herself argues that ME is not all that restrictive anyway since it must be overcome in at least two

instances. Even without these two situations, ME is still not an all-or-none constraint. Golinkoff et al. (1992) demonstrated that there was only a small statistical difference between children who reject a new term if they already have a label for an object and children who accept a new term given the same conditions. Hence, a more accurate depiction of ME would be as a probabilistic bias or perhaps a default assumption that children must regularly override (Merriman & Bowman, 1989; Woodward & Markman, in press).

Nonetheless, Markman (1991) claims that constraints such as these are necessary for children even to break into language. They must, perforce, be operative at or before the time infants begin to use language during the first part of the second year of life. Indeed, there is some evidence that children follow taxonomic assumptions when novel labels are provided as early as 18 months, and that 2-year-olds respect ME (Woodward & Markman, in press). But this last point is controversial. Using perhaps slightly more demanding tasks for 2-year-olds, Merriman and Bowman (1989) concluded that children younger than 30 months do not have a mutual exclusivity bias.

A further criticism of Markman's view of constraints on lexical acquisition is that they seem to be merely descriptive of generalizations arising from the facts of lexical acquisition. To have greater explanatory validity, restricting constraint theorists must specify mechanisms

that allow children to override ME rather than just identify two instances where this appears to occur. Markman must also explain why the presence or absence of a label should lead children to generalize according to taxonomic or thematic principles. After all, 3-year-olds' initial assumptions about the meaning of novel motion verbs are virtually unaffected by the presence or absence of a novel verb label (Forbes & Farrar, in press). Forbes and Farrar speculate that nonlanguage-specific knowledge such as causal concepts serve as clues about how novel motion verbs and events can initially be represented in the lexicon or organized in memory. Hence, the mere presence of a verb label (with minimal further syntactic information) provides little additional useful information about the meaning of a novel verb. Without some explanation of why the presence or absence of a novel object label should affect children's initial interpretation of novel lexical items, we can not understand why children observe ME given one set of circumstances but disregard ME in other situations.

For present purposes, a complete theoretical account of the representational form of the taxonomic assumption, whole object constraint, and ME, along with the age of onset is unnecessary. Constraints may be innately specified analog or propositional content knowledge, or some form of procedural knowledge such as perceptual analysis (Mandler, in press) or representational redescription ability



(Karmiloff-Smith, 1991). But when and in what form constraints emerge is not really the crucial issue for my purposes. I seek only to review how a restrictive constraints perspective frames research on lexical acquisition and compare that with how an enabling constraints perspective approaches the same task. It is to this latter perspective that I now turn.

#### Lexical Acquisition Research Based on the Enabling Constraints View

Framing word learning as a formal logical induction problem has led many adherents to regard word learning as a "point and name ostension paradigm" (Nelson, 1992). Unfortunately, this model of the child's induction problem is misleading in that it assumes that children must learn only object labels and then only in situations entirely divorced from any supporting contextual cues. Moreover, proponents of restrictive constraints tend to view children, devoid of social cognitive or social learning skills, as the only unit of analysis in explanations of how language is acquired. Since lexical acquisition has been conveniently located entirely within the child, the child has been credited with powerful, innate language specific learning mechanisms to overcome the wildly exaggerated indeterminacy of word meaning. Restrictive constraints are made necessary only because the social, communicative, pragmatic character

of language has been reduced nearly to the level of mere noise.

Enabling constraints theorists, on the other hand, tend to explain how young children make productive use of three distinct, yet interrelated sources of information. One of these sources consists of children's available conceptualizations that they bring with them to any language learning situation. Many theorists have argued that children's earliest lexical acquisition consists of their learning the label of previously established concepts such as those learned during the course of familiar events (Gopnik & Meltzoff, 1986; Mervis, 1987; Nelson, 1985). Event familiarity facilitates 2-year-olds' language development, in part, by providing a conceptual framework for children to interpret novel lexical forms and functions (Farrar, Friend, & Forbes, in press).

Children are remarkably proficient at acquiring lexical items by modelling those used by adults in contexts that are partially, but not fully accounted for by their cognitive models (Nelson, 1992). Nelson refers to this ability as the principle of "Use Before Meaning." Children's skill in apprehending at least part of a word's meaning from even a single context in which it is used was originally termed "fast mapping" (Carey & Bartlett, 1978). However, the principle of Use Before Meaning better suggests the social-cognitive, -imitative, and -learning skills that children

make use of during the course of early lexical acquisition as well as other cognitive achievements. Additional mechanisms must be specified to account for the often slow and uncertain process of how children acquire the conventional adult meaning of novel words.

One such mechanism, and another source of information in lexical acquisition that children exploit, is customized instruction offered by more experienced others. Even if infants came pre-equipped with innate constraints, biases, and other skills (e.g., social imitation) to facilitate their learning of object labels, this knowledge would be for naught without an environment to motivate its expression. And the immediate environment with which infants come into contact is often their mothers, who are already well versed in language and eager to pass on their knowledge. Obviously, mothers can not do it all for their children. Child directed speech, fine tuning, and maternal labeling practices are socially distributed processes--not wholly located within the child, not wholly localizable within the more experienced other. Thus word learning has been characterized as a social convergence process because children converge on the adult usages through various forms of apprenticeship (Adams & Bullock, 1986; Rogoff, 1990).

The two-way give-and-take view of early word acquisition is nicely illustrated by Adams and Bullock (1986) using a joint picture book naming task. Mother and

child dyads were given a picture book containing drawings from six different categories of animals. Animals varied in typicality (basic-get example, typical subordinate-get example, atypical subordinate-get example) and context (i.e., presented with members of similar or dissimilar typicality). Mothers were asked to play with their children as they normally would using the picture book. Adams and Bullock found that the labels mothers provided were not simply given as a function of their children's age, but also of typicality and context. Apparently, mothers were not only attuned to their children's current level of understanding (a function of the child's age) but also to how their children's understanding would be affected by different aspects of the same learning situation. For example, mothers identified atypical members using a subordinate label at above chance levels for children in all three age groups, but only in contexts where just atypical exemplars were presented. The researchers also found a global shift in the labels children provided following their mothers' labeling practices. Adams and Bullock interpret these data as evidence for mothers' accommodating to their children's increasing lexical development, to dyads' agreement about their joint focus of attention, and to children's gradual convergence on more adult patterns of word usage.

Results also showed that mothers initially carried the bulk of the labeling responsibility. Children's beginning word production, and presumably their word comprehension as well, was insufficient to allow participation on an equal footing in picture naming. Gradually, children assumed proportionately greater naming responsibility as they began to converge on the adult patterns of picture labeling. This dynamic pattern of picture naming, Adams and Bullock (1986) argue, demonstrates a shift in responsibility within the picture naming task "indicative of the transition from the interpsychological to the intrapsychological plane, that is, of the transformation of a shared activity into an internalized activity" (p. 184).

While the preceding study does demonstrate how lexical acquisition and extension can be conceptualized as a socially distributed process, so far, the precise social mechanisms that actually drive the process have not been discussed. Specific lexical learning mechanisms identified by Adams and Bullock (1986) include hedges (e.g., "A penguin is a funny kind of bird." p. 187) which serve to expand child categories to include atypical instances. Modifying phrases using labels to highlight distinctive perceptual attributes (e.g., "A zebra is a horse with stripes.") were also used to identify category membership at other than the basic level. Furthermore, mothers would specifically identify functional attributes of objects, (e.g.,

"[Penguins] are birds that live at the South Pole and they swim and they catch fish.") to help their children override salient, but misleading perceptual and functional attributes. Mervis (1987) found that the most successful strategy mothers use in furthering their children's lexical development involves introducing an object's name in conjunction with a concrete demonstration of perceptual attributes and defining functions.

To this short list, must be added what Trevarthen and Hubley, (1978) have termed "secondary intersubjectivity." This refers to participation in triadic interactions (I-Thou-It) which allow children to construct with more experienced others a world of shared events to converse about in the first place (Schaffer, 1984). The importance of such interactions for word learning is supported by the positive correlation between autistic children's ability to participate in episodes of joint attention and their ability to learn and appropriately use new linguistic forms (Landry & Loveland, 1986). In general, autistic children have difficulty in understanding the meaning and use of language precisely because of profound disturbances in their social relationships (Gordon, 1987).

All of the preceding mechanisms drive children's lexical acquisition by guiding their active efforts to acquire more adult-like object label knowledge and usage. Guidance consists of explicit verbal and nonverbal child

centered instruction. Children become increasingly able to capitalize on the diverse instructional techniques offered. Instruction is effective precisely because of children's active involvement in the ongoing social activity, such as picture labeling, or mother-child interaction with toys or other objects.

A third source of information children use which enables them to acquire and correctly extend novel object words is the kind of object with which a novel lexical item is modeled. Tomasello, Mannle, and Werdenschlag (1988) hypothesized that children's acquisition of a target word at time two would be affected by the kind of training they initially received at time one. To test this hypothesis, the authors used a training study to assess children's production and comprehension of novel object words (e.g. sax) learned after having previously learned new words. The previous learning occurred in two conditions. In the "similar" condition, children were first taught the name for a highly similar object (e.g., horn). In the "dissimilar" condition, children were initially taught the name of a highly dissimilar object (e.g., hook). Subsequently, children's spontaneous production and comprehension of novel target words (e.g. sax) were assessed. Overall, children had an easier time learning words (e.g., sax) whose referents were highly similar to those of words they already knew (e.g., horn).

This finding clearly shows that young children's acquisition of a new object word is affected by their knowledge of previously learned words with similar referents. Tomasello et al. (1988) point out that the similar-referent word had many overlapping features with the subsequent target word. This, Tomasello et al. claim, facilitated the children's task of determining which features of the target word were relevant in assigning the new adult label. Conversely, the dissimilar-referent was so different from the target word that the child's task of determining which were the relevant features in assigning the adult label was made more difficult.

By expanding the language learning space to include the child in context, the enabling constraints view promotes an alternative depiction of the cognitive mechanisms of language acquisition. Restricting constraints are replaced by children's ability to interact with more experienced others, participate in episodes of joint attention and imitate others, form concepts of objects and activities experienced in routine events, as well as create and use categories of conventional symbols (Tomasello, 1992b). This is not to say that such theorists assume that infants are not biologically prepared to acquire language. On the contrary, the disagreement is on the nature of the biological endowment, not on whether there is one (Bates, 1988; Tomasello, 1992b). In effect, the infant's biological



preparedness to acquire language has been redefined in accord with an alternative view of language learning rather than minimized or denied.

#### Importance of Verbs in Early Language Development

As is evident from the preceding review, most of the research based on the restrictive or enabling constraints view of early lexical acquisition focuses almost exclusively on concrete object nouns. But language involves much more than knowledge about lists of words. The very glue that binds words together and gives language its generativity is verbs. Verbs do so, according to Braine (1976), by functioning as conceptual frames which provide a structure for larger lexical units. Braine argues that very young children's understanding of the meaning and function of verbs allows them to make the crucial transition from one- to two-word utterances, thereby demonstrating some knowledge of the rules and structure of language. However, Tomasello (1992a) claims that before children have any knowledge of verbs as a grammatical category, their verb knowledge resembles "conceptual islands" around which meaning and argument structure slowly accrue and are subsequently generalized. Only during the third year of life, and then only "mosaically," do children begin to construct a grammatical category of verb (Rispoli, 1991; Tomasello, 1992a). From the very beginning of this long period of developing verb knowledge, verb meaning interacts with

syntax. Even very young children rely on their knowledge about verb definitions and conflation classes (i.e., the semantic elements that may occur together in a given language) to decide which verbs may correctly go with what argument structures (Pinker, 1989). Given the importance of verb meaning and conflation classes, it is surprising that so little empirical study on how children acquire this information has been undertaken.

### Verb Representation

A serious impediment to the study of verb acquisition is that very little is known about how children, or adults for that matter, represent verb meaning. A reasonable and widely used strategy for studying verb representation is to first observe how children and adults use verbs. When children's usage does not differ from that of adults, one can assume that they represent meaning in roughly the same way. When children's usage does differ from that of adults, one can assume that they represent meaning differently.

Based on a diary study of his daughter's (T) verb usage during her entire second year of life, Tomasello (1992a) found evidence for two very broad categories of verbs. One category comprised what Tomasello called change of state verbs. The characteristic feature of verbs in this category is that they all encode situations involving a transformation of some kind (e.g., break, bring). Additionally, change of state verbs generally have well

defined beginning and end points. The other broad category comprised what Tomasello called activity verbs. These verbs were defined as actions performed by people or other animals that do not involve transformations (e.g., climb, watch). Interestingly, some of T's activity verbs (e.g., paint) were what adults would use as change of state verbs. For example, T used paint primarily to refer to the activity of painting rather than to the transformation of an unpainted surface to a painted one.

Tomasello (1992a) claims that T's verb usage highlights several important characteristics of verbs that even beginning word learners use to distinguish them from other lexical items. One very obvious property that differentiates verbs from nonverbs is the role of temporal sequence (p. 15). Moreover, T's change of state and activity verbs were differentiated by which aspect of the temporal sequence was highlighted. T's change of state verbs emphasized the result or outcome of an event, whereas her activity verbs emphasized the manner in which the event took place. For change of state verbs, perhaps the temporal sequence was especially well delineated because these verbs encode events with definite beginning and end points.

Other researchers have focused on whether some aspects of events are more central to verb meaning than others. Gentner (1978), for example, found that children more readily learned and accurately discriminated action verbs

encoding manner-of-motion (e.g., stirring) than those encoding change-of-state (e.g., mixing). Based on her analysis of children's spontaneous speech along with experimental evidence, Bowerman (1982) found that children's overextensions of the verb fill were consistent with a manner-over-end-state bias. More recently, Gropen, Pinker, Hollander, and Goldberg (1991) found that children between two and six years of age misinterpret the manner of action as more important for the meaning of verbs such as fill and empty. In fact, the defining feature of these verbs is the end state: Whether a container ends up filled or emptied. Moreover, Gropen et al. found that children's misinterpretations led to specific kinds of syntactic errors involving the same verbs.

However, for seemingly related, but completely novel verbs the manner-over-end-state bias is not always observed. For example, Behrend (1990) taught children and adults novel verbs using brief, unconventional videotaped action events. After training, children were asked whether other events were examples of the new action verb. These other events were identical to the training events except that a single element of meaning had been changed. Behrend found result changes made children less likely than manner changes to generalize the novel verb. Using a similar paradigm, Forbes and Farrar (in press) found that causative agent changes

made children less likely than manner changes to generalize novel motion verbs.

One way to reconcile these differences is to suggest that a manner bias occurs more often for familiar verbs while a result bias occurs more often during the learning of completely novel verbs. The two studies reported in this dissertation will contribute to the construction of a more complete developmental account of verb representation.

### Verb Learning Constraints

Like verb representation, there is little systematic understanding is how children learn the meaning of novel verbs and then generalize them to appropriate situations. Golinkoff, Jacquet, and Hirsh-Pasek (1992) blaze a path into the unknown by proposing that children's action verb learning is expedited by principles of "category scope" for action verbs--or "action scope" (AS) and "novel name, nameless category" (N3C). The former principle refers to situations in which children act as though verbs labeling action events are extended to events of the same type regardless of superficial differences of the manner in which the action is performed or a change of agent performing the action. N3C refers to situations in which children assume a novel verb refers to an unnamed novel action rather than to a just-named novel action.

To test whether very young children's action verb learning proceeds according to these principles, Golinkoff

et al. (1992) presented 34-month-olds with two-dimensional drawings depicting familiar and unfamiliar actions. In one condition children were shown two familiar actions, one just-learned but performed by a different agent, and one novel action. Results indicated that children generalized a new action verb to the just-learned action in spite of the agent change at frequencies significantly higher than the level of chance. In another condition children were shown two familiar, one just-learned action, and one novel action. Results indicated that children generalized a novel verb to a previously unnamed novel action at significantly higher than chance levels. Thus Golinkoff, Jacquet, and Hirsh-Pasek (1992) claim to have adduced empirical support for N3C and AS for action verbs.

Several limitations of the above paradigm restrict the scope of the conclusions. One is that Golinkoff, Jacquet, and Hirsh-Pasek (1992) chose to test for principles of verb learning in young children using two-dimensional drawings of actions! Novel name nameless category was originally proposed as a principle of noun learning (see Golinkoff, Mervis, & Hirsh-Pasek, 1992). In fact, Golinkoff, Mervis, and Hirsh-Pasek (1992) found that young children do generally assume that novel object labels refer to previously unlabeled objects. A principal aim of Golinkoff, Jacquet, and Hirsh-Pasek (1992) was to determine whether N3C was a more broadly applicable principle of lexical items

other than just object labels. Action scope derives from category scope, which is another object label learning principle identified by Golinkoff, Mervis, and Hirsh-Pasek (1992). Indeed Golinkoff, Mervis, and Hirsh-Pasek (1992) found that shape was the primary criterion young children use in their generalizations of object words. Thus another aim of Golinkoff, Jacquet, and Hirsh-Pasek (1992) was to identify key criteria for children's extension of verbs. Deriving verb learning principles from principles proposed to account for object label learning may be a perfectly reasonable strategy for studying verb acquisition. Unfortunately, the researchers elected to test N3C and AS for actions depicted by two dimensional drawings. Obviously, drawings resemble concrete object referents more than dynamic, transitory, action events. Because Golinkoff, Jacquet, and Hirsh-Pasek (1992) used pictures of actions, rather than actions per se, it is unclear whether N3C and AS adequately characterize children's action verb learning.

A further limitation of the Golinkoff, Jacquet, and Hirsh-Pasek (1992) study is that AS for action verbs was incompletely tested. Although the researchers did test the principle of AS for agent changes, they did not do so for differences in the manner in which an action is performed. In view of the methodology used, this was a perfectly appropriate procedure. Still, action verbs do vary in ways other than in terms of the agent performing the action.

From the brief reviews of verb learning and representation, it is clear that children do consider some elements of action verb meaning to be more important than others. Somewhat problematically, the same biases are not consistently found across different studies. Also virtually unknown is how biased interpretations of verb meaning may change developmentally. Nor is much known about whether verb learning biases can be altered or even changed by different kinds of verb learning experiences.

#### Action Events and Verb Learning

The overall objective of the two experiments reported in this dissertation was to examine how children and adults interpret and generalize novel action verbs. All of the verbs used labeled events which consisted of actors using particular instruments to act in a given manner on objects to effect an outcome. For example, faufing referred to a person using a fixed cup remover (i.e., a specialized bicycle wrench) to lift two plastic bottles over a ramp and lay them onto a stool. According to Slobin (1985), these events are best characterized as "manipulative activity scenes," which number among the events about which children are first motivated to talk (Tomasello, 1992b). Bruner (1990) claims that this basic manipulative activity scene is common to narratives the world over. Bruner further specifies that such narratives typically involve some outcome.



Experiment 1 determined the importance adults accord manner, outcome, instrument, and agent in their initial interpretation of verbs referring to manipulative activity scenes. To do this, adults were first taught novel verbs using videotaped manipulative activity events. Next, subjects were asked whether these verbs labeled other manipulative activity events in which only the manner, outcome, instrument, or agent had been changed. Subjects should have been comparatively less likely to extend the novel verbs to events in which a component, interpreted as more central to the meaning of the verb, had been changed. More specifically, manner and outcome changes should have rendered adults less likely to generalize than agent and instrument changes (Behrend, 1990; Forbes & Farrar, in press; Gentner, 1978).

Four complete events used in Experiment 1 were selected for use as experimental stimuli in Experiment 2. The criterion for selection was those events that best exemplified the overall pattern of generalizations for agent, instrument, manner, and outcome changes.

#### Initial Exemplar Effects on Children's and Adults' Verb Interpretations and Generalizations

Certainly very young children's earliest productive word use is highly situational. Their early attempts to use words are very much tied to the exact situations and routine events within which they are initially modeled (Barrett,

1985; Nelson, 1985; Snyder, Bates, & Bretherton, 1981).

Part of children's word learning task is to appropriately extend words beyond the exact context in which they were learned. This important ability signals children's developing understanding of words as representative symbols for classes of similar objects, events, states, actions and so on (Nelson, 1985).

Very little research has specifically addressed the process of verb generalization. Smith and Sachs (1990), looked at the relationship between event representation, verb production, and verb comprehension in different contexts. For children under two years of age, Smith and Sachs suggest that their ability to represent events through sequences of actions is positively related to contextual flexibility in verb comprehension. The focus of the Smith and Sachs study was very young children's conceptual basis for developing verb comprehension and production. No study that I am aware of has specifically examined how children's or adults' interpretation and generalization of novel action verbs are affected by differences in the kind of initial exemplars from which they are learned. Yet children must come to understand (like adults) that the meaning of a verb like to hammer is not tied to a specific person, an exact manner, a certain result, or even the instrument. After all, almost anyone can hammer, but a carpenter is bound to hammer differently (i.e., more efficiently) than a first

time hammer user. Hammering does not always, alas, result in driving a nail straight through wood to its head, nor is it even necessary to use a hammer to hammer. Thus depending on children's initial exposure to a hammering event, children could have a different interpretation of hammering.

Two issues were of particular interest in Experiment 2. The first concerned whether children's initial assumptions about the meaning of action verbs undergo developmental change. Consequently, children's and adults' interpretations of novel action verbs were directly compared. The importance subjects accorded a particular element of meaning was again inferred from the pattern of verb generalizations. Children and adults would presumably be less inclined to extend a newly learned action verb to situations in which an important element of meaning had been changed. Developmental differences in initial assumptions would be consistent with the enabling constraints perspective focus on lexical acquisition principles acquired during the course of word learning.

The second issue was whether children's and adults' biased interpretations could be attenuated or even changed by different types of verb experiences. Subjects were first shown brief videotapes depicting novel action events in one of three conditions: Same, constant plus noise, and different. In the same condition, subjects viewed three versions of the same training event. In the constant plus

noise condition, only one of the four event components was held constant across the three training events. For example, holding the manner component constant in the faufing event resulted in subjects viewing the same manner, but with a different agent, instrument, and outcome. For the different condition, subjects viewed three different versions of either the manner, instrument, agent, or outcome of the event, while the other components were held constant. For instance, varying the manner component in the faufing event resulted in subjects viewing three different manners in which the event occurs (e.g., bottles are lifted and placed onto the stool, bottles are launched up the ramp and land on the stool, and bottles are tossed onto the stool). Thus while the manner component changed in each of the three training events, the agent, instrument, and outcome components remained unchanged. In sum, subjects in the same, constant plus noise, and different conditions saw (a) one version of the training event three times, (b) three versions of the training event in which one event component remained constant while the others varied, or (c) three versions of the training event in which only one event component varied across all three versions.

After the training trials in all three conditions, subjects were shown a single generalization trial that varied on one component from the training events. After viewing the generalization trial, subjects were asked

whether it was an example of the novel verb. This generalization trial was held constant across all three training conditions. To continue with the faufing example, subjects in all three conditions saw another faufing event, but with a different manner. So any differences in verb generalizations between groups were due to differences between the kinds of initial exemplars used to model the novel verbs.

The same condition was designed to show subjects' initial assumptions about the importance of specific components of action verb meaning. In effect, they were "told" that each of the components were equally important. Differences between generalizations for verb components would indicate which elements of action verb meaning were most central in children's and adults' initial interpretations. The different condition was designed to reduce subjects' initial assumptions about the importance of the very same elements of verb meaning. In effect, they were "instructed" that a particular component was not important to verb meaning since they saw three different instantiations of it. The extent to which subjects ignore this information indicates the relative strength of their specific verb learning biases. Subjects in the constant plus noise condition viewed three events in which only one element remained constant and the others varied. This condition was designed to moderately increase subjects'

initial interpretation about the importance of specific components of action verb meaning. In effect, subjects were informed that one of the verb components was more important than the remaining components.

Of final interest from Experiment 2 was whether children and adults differed in (a) the total number of generalizations they made, and (b) the number of generalizations in each initial experience condition. Forbes and Farrar (in press) found that children generalized novel motion verbs more conservatively than adults. Consequently, it was predicted that children in all three experimental conditions would be less likely to generalize the novel action verbs than adults. Moreover, subjects viewing three nearly identical training events should have been least likely to generalize the novel verb. Showing subjects three different versions of a novel action verb should have made them most likely to generalize. And the conflicting information in the constant plus noise should have resulted in subjects accepting an intermediate number of generalization trials as an example of the novel verb.

## CHAPTER 2 EXPERIMENT 1

### Method

#### Subjects

Participants comprised 36 young adults. Adults were college undergraduates who received course credit for participating. Equal numbers of females and males within each age group took part. Only native English language speakers were tested.

#### Materials

Videotaped training events depicting novel action events were used to teach subjects seven different novel verbs. The events were novel insofar as seven different adults were filmed using an instrument to effect a unique action resulting in an original outcome. Four event components of principle interest included: Agent, instrument, manner of action, and outcome. Faufing, for instance, involved an adult (agent) using a fixed cup remover (instrument) to lift and place (manner of action) two bottles onto a stool (outcome). Thus, training events were not so novel that they are not generalizable to the population of action events.

All generalization trials consisted of events in which only one of the four components of interest varied from the

training event. Specifically, the four generalization trials resembled the training event in all respects except for a change of agent, manner-of-action, instrument, or outcome. A change of agent consisted of a different person performing the action. Changes of manner were accomplished by varying the way in which the person accomplished the outcome. Instrument changes involved varying the tool used in the action event. Outcome changes will involve varying the result of the action event. Three slightly different versions of every generalization trial were filmed for a total of 84 generalization trials.

All training and generalization trails lasted between 12 and 15 seconds each. Training events for novel verbs and generalization trials are outlined in the Appendix. All of these events were video-recorded using a VHS camera and displayed using a color monitor.

#### Procedure

Every subject viewed the same seven training events three times each. Training events were introduced by the experimenter in the following way: "Watch this." "That was xing," where x represents a novel verb root. The experimenter showed each training event twice more saying: "Watch again," and "Watch once more" before the onset of the event followed by: "That was xing" after the event had been shown.



Immediately after the third repetition of the different training events, each subject was shown one of each kind of generalization trial (agent, instrument, manner, and outcome) in one of the three conditions. Conditions 1, 2, and 3 consisted of slightly different versions of all 28 generalizations trials. Thus each subject such saw a total of 49 events: 21 training and 28 generalization events. For half of the generalization trials subjects were instructed to watch the video and asked: "Was that xing, or was that something else?" For the other half of the generalization trials, the order of the query was reversed: "Was that something, or was that xing?" Query type was counterbalanced across generalization trials.

After the first block of training and generalization trials the experimenter informed the subject that there would be six more occurrences of the same procedure, but using different events and words. Training and generalization events were shown in one of four random orders. Subjects were tested individually and a complete session lasted about 20 minutes.

## Results

### Analysis of Novel Action Verb Generalizations

Subjects' generalizations were defined as the number of times they accepted a generalization trial as an example of the novel verb. These generalizations were summed across all seven verb events for every change trial and then

averaged across subjects. The highest obtainable mean score was seven. A high mean score for a given change type indicates that subjects were more likely to generalize the novel action verb. Conversely, a low mean score for a given change type indicates that subjects were less likely to generalize the novel action verb.

One objective of Experiment 1 was to determine the relative importance adults accord manner, outcome, instrument, and agent in their initial interpretation of verbs referring to manipulative activity scenes. Table 1 gives the mean number of generalizations, summed across all seven events, by type of change trial (i.e., agent, instrument, manner, outcome), and event version. Overall, outcome and manner changes most consistently rendered adults least likely to generalize the novel verbs. Adults' generalizations to outcome changes were lower than to those for manner changes. Adults accepted agent changes more often than any other change type. Adults' generalizations for instrument changes were intermediate between those for agent and manner.

Table 1. Mean Number of Action Verb Generalizations (and Standard Deviations) Summed Across Event, by Event Version, as a Function of Change Type for Experiment 1.

Version	Change Type				Overall
	Agent	Instrument	Manner	Outcome	
1.....	5.67 (1.83)	3.83 (1.03)	2.58 (1.93)	1.42 (1.24)	3.38 (1.03)
2.....	6.83 (0.40)	5.50 (1.31)	3.33 (1.87)	2.00 (1.81)	4.42 (0.82)
3.....	6.75 (0.45)	5.08 (1.91)	3.67 (2.01)	2.08 (0.52)	4.40 (1.25)
Total.....	6.42 (1.20)	4.81 (1.03)	3.19 (1.93)	1.83 (1.24)	

Note. Highest possible score = 7.

The importance of individual change types in adults' interpretation of novel action verb meaning was analyzed using a 4 (Change Type: Agent vs. manner vs. instrument vs. outcome) x 7 (Event: Blating vs. faufing vs. noffing vs. oushing vs. prebing vs. smuking vs. tulking) x 3 (Version) mixed analysis of variance with repeated measures on change type and event. The analysis revealed a significant three-way interaction between change type, event, and version,  $F(36, 594) = 1.92$   $p < .001$ . So not only did adults'

generalizations for individual change types vary across the verb events, but they also varied across the different versions of the verb events.

The second objective of Experiment 1 was to select events, within and across which the pattern of generalizations did not meaningfully vary, for use in Experiment 2. Thus the absolute number of generalizations between event versions for a specific change type is relatively unimportant. What does matter, is whether generalizations among the four change types, within each of the three different event versions, do follow the overall pattern of generalizations shown in Table 1. For this reason, a useful way to examine the significant three-way interaction is by focusing on how the change type by event portion of the interaction differs across the three event versions. Table 2 conveniently provides adults' mean proportion of generalizations by change type and event, for the three different versions of the verb events.

Table 2. Mean Proportion of Generalizations by Verb Event, Change Type, and Version of Verb Event.

Event	Change Type			
	Agent	Instrument	Manner	Outcome
Version 1				
Blating	0.75 (0.45)	0.42 (0.52)	0.25 (0.45)	0.08 (0.29)
Faufing	0.92 (0.29)	0.50 (0.52)	0.25 (0.45)	0.17 (0.39)
Noffing	0.83 (0.39)	0.50 (0.52)	0.33 (0.49)	0.08 (0.29)
Oushing	0.83 (0.39)	0.75 (0.45)	0.42 (0.51)	0.08 (0.29)
Prebing	0.58 (0.52)	0.58 (0.52)	0.42 (0.51)	0.50 (0.52)
Smuking	0.92 (0.29)	0.75 (0.45)	0.50 (0.52)	0.08 (0.29)
Tulking	0.83 (0.39)	0.33 (0.49)	0.42 (0.52)	0.42 (0.52)
Version 2				
Blating	0.92 (0.29)	0.58 (0.52)	0.08 (0.29)	0.17 (0.39)
Faufing	1.00 (0.00)	0.75 (0.45)	0.42 (0.52)	0.33 (0.49)

Table 2 continued.

Event	Change Type			
	Agent	Instrument	Manner	Outcome
Noffing	1.00 (0.00)	0.83 (0.39)	0.33 (0.49)	0.25 (0.45)
Oushing	1.00 (0.00)	1.00 (0.00)	0.58 (0.52)	0.25 (0.45)
Prebing	0.92 (0.29)	0.75 (0.45)	0.83 (0.39)	0.67 (0.49)
Smuking	1.00 (0.00)	1.00 (0.00)	0.50 (0.52)	0.08 (0.29)
Tulking	1.00 (0.00)	0.58 (0.52)	0.58 (0.52)	0.25 (0.45)
Version 3				
Blating	1.00 (0.00)	0.83 (0.39)	0.08 (0.29)	0.50 (0.52)
Faufing	1.00 (0.00)	0.58 (0.52)	0.58 (0.52)	0.17 (0.39)
Noffing	0.92 (0.29)	0.83 (0.39)	0.83 (0.39)	0.58 (0.52)
Oushing	0.92 (0.29)	0.83 (0.39)	0.25 (0.45)	0.25 (0.45)

Table 2 continued.

Event	Change Type			
	Agent	Instrument	Manner	Outcome
Prebing	0.92 (0.29)	0.92 (0.29)	0.75 (0.45)	0.00 (0.00)
Smuking	1.00 (0.00)	0.83 (0.39)	0.75 (0.45)	0.33 (0.49)
Tulking	1.00 (0.00)	0.25 (0.45)	0.42 (0.52)	0.25 (0.45)

Inspection of Table 2 reveals that the majority of generalizations by change type and event conform to the overall pattern shown in Table 1. Namely, adults generalized least often to outcome changes and most often to agent changes. Furthermore, their generalizations for instrument changes generally exceeded those for manner changes. Two obvious exceptions to this overall pattern can be seen in the mean proportion of generalizations for manner changes within the blating, prebing, and tulking events. For versions two and three of blating, along with version one of prebing, adults generalized to manner changes less often than to outcome changes. This pattern contrasts with the remaining 18 (of a possible 21) instances where adult

generalizations to manner changes exceeded (16) or equalled (2) generalizations to outcome changes. A second exception to the overall pattern of generalizations occurred primarily with the tulking and prebing events. Across the three versions of tulking and for version two or prebing, adults generalized to instrument changes equally or less often than to four manner changes and three outcome changes.

Two further minor differences from the overall pattern of change type by event generalizations were noted. For version three of oushing, the mean proportion of generalizations for manner changes equaled that for outcome changes. Secondly, generalizations for agent and instrument changes were equal (and at or near ceiling) for oushing (version 2), prebing (version 3), and smuking (version 2).

#### Selection of Four Events for Use in Experiment 2

Thus far the analysis indicates that generalizations varied least across the three versions of faufing, noffing, oushing, and smuking. Generalizations were further analyzed using a 4 (Event: Faufig vs. noffing vs. oushing vs. smuking) x 4 (Change Type: Agent vs. instrument vs. manner vs. outcome) analysis of variance with repeated measures on event and change type. Generalizations were collapsed across event version because they did not appear to meaningfully differ between the three versions. This analysis showed that generalizations to individual change types significantly interacted with event,  $F(9, 315) = 2.09$ ,



$p < .03$ . To assess how generalizations to each of the four change types varied across the four different events, the scores must first be averaged across all three levels of event version.

#### Event effects on initial assumptions

Table 3 shows adult's mean proportion of generalizations by change type and event, collapsed across the three different versions of the verb events. Proportions are given because for each individual change type within a given verb event, adults could either accept or reject the change as an example of the novel verb.

An examination of Table 3 reveals that the pattern of generalizations across the four events was virtually identical. Mean generalizations for each change type always followed the same pattern within each of the four events: Adults generalized least often to outcome changes, most often to agent changes, and their generalizations for instrument changes exceeded those for manner changes.

Table 3. Mean proportion of Action Verb Generalizations (and Standard Deviations) by Event and Change Type, Collapsed Across Version.

	Change Type			
	Agent	Instrument	Manner	Outcome
<u>Event</u>				
Faufing	0.97 (0.17)	0.61 (0.50)	0.41 (0.50)	0.22 (0.42)
Noffing	0.92 (0.28)	0.72 (0.45)	0.50 (0.51)	0.31 (0.47)
Oushing	0.92 (0.28)	0.86 (0.35)	0.42 (0.50)	0.19 (0.40)
Smuking	0.97 (0.17)	0.86 (0.35)	0.58 (0.50)	0.17 (0.38)

Note. Highest possible score = 1

Because the effect of change type did significantly vary across the levels of event, a posteriori comparisons of change types within each verb event were made. All of the following comparisons were conducted using the Bonferonni adjustment to maintain familywise alpha at .05. Within all four events, adults generalized to agent changes significantly more often than outcome as well as manner changes. Adults also generalized significantly more often

for instrument compared to outcome changes within all four events. Contrasts of agent and instrument changes showed that the difference was significant only for faufing and noffing. Contrasts of instrument and manner changes showed that the difference was significant only for oushing and smuking. Finally, for smuking only, was the difference in generalizations between the manner and outcome change types significant.

### Discussion

Experiment 1 had two principle aims. One of these was to demonstrate the relative importance of individual event components in adults' interpretation of novel action verb meaning. Based on their overall pattern of generalizations, adults almost invariably considered the outcome and manner changes more essential than instrument and agent changes in their initial interpretation of the novel events. With few exceptions, adult word learners extended novel action verbs to events in spite of agent changes. This result partially supports Golinkoff and coauthors' (1992) claim that action verb acquisition proceeds according to a principle of AS. Action scope also predicts that word learners will extend novel action verbs to events regardless of superficial differences in the manner in which actions are performed.

The current study shows that relatively slight changes in the manner of action can notably affect adults' generalizations of novel action verbs in different ways.

For example, adults generalized least often to outcome changes in version one of blating, but generalized least often to manner changes in versions two and three of the same event. Evidently, standing and pulling up, away, then dropping the near end of a table figured more prominently in adults' interpretation of blating than either a) standing and pulling up, toward, then dropping the far end of a table; or b) kneeling and pushing up, then dropping the far end of a table. On the other hand, adults generalized to manner changes more often than to outcome changes in all three versions of faufing (and to most of the other events as well). Yet each manner change for faufing was different. Two bottles were dragged into place (version 1), tossed underhand into place (version 2), or launched up a ramp into place (version 3).

This empirical evidence suggests that tossing compared to dragging bottles in place is relatively equivalent, whereas pulling a table up and away from oneself compared to pulling a table up and toward oneself is not. Unfortunately, AS states only that verbs for action events will be extended to events of the same type regardless of superficial differences in the manner of action. Action scope could be retained in a more complete theory of lexical acquisition. But results from Experiment 1 signal the need to explain more precisely what constitutes a superficial

difference between two manners of action for the same type of event.

Results from the current study also accord with those of Behrend (1990). The paradigm of the current study was very similar to that used by Behrend. In the generalization phase of the Behrend study, adults and children were asked whether novel action verbs extended to events in which only the result, manner of action, or instrument differed from the original training event. As in the current study, Behrend found that result changes had the greatest effect, action changes an intermediate effect, and instrument changes the weakest effect. For both studies, a greater effect meant that subjects were less likely to extend the novel verb.

Behrend (1990) suggested that the findings could be explained in terms of a "result verb bias." Such a bias could, as Behrend suggests, facilitate verb learning by restricting word learners hypotheses about what novel action verbs mean. In the current study, result changes did not always render subjects least willing to generalize the novel verbs. In nearly one third of the total number of cases, mean generalizations for manner or instrument changes were less than or equal to those of result. Obviously, the larger context in which result changes play a role (albeit an important one) affects how result changes influence word learners interpretation and generalization of novel action

verbs. In other words, verb learning is affected not only by principles and biases held by word learners, but also by the very events from which verbs are learned.

Certainly more than a principle of AS and a result verb bias is needed to adequately characterize the process of verb generalization. Interpreting then subsequently generalizing novel action verbs is a more dynamic process than either the principle of AS or a result bias suggest. Superficial changes of the manner in which an action takes place may not be important in isolation. What may be important in determining whether a particular verb will be extended to similar situations is how such changes interact with other components of action verb meaning.

Experiment 2 more systematically explores how the context in which the initial training occurs affects generalizations--and by inference, initial interpretations of action verb meaning. Of primary interest in Experiment 2 was how differences between the kinds of events from which novel action verbs are learned affect children's and adults' verb interpretation and generalization.

Therefore, a second aim of Experiment 1 was to select four events for use in Experiment 2. For Experiment 2, it was important that the pattern of generalizations did not meaningfully vary within or across the events used as stimuli. The pattern of generalizations within and across faufing, noffing, oushing, and smuking, best exemplified the

overall pattern of generalizations observed for all seven events combined. All four change types affected generalizations in the same way for each of the selected events. Thus differences in generalizations observed in Experiment 2 are due to the experimental manipulation rather than to properties of the stimuli.

## CHAPTER 3 EXPERIMENT 2

### Method

#### Subjects

Participants included 64 3-year-olds (mean = 3;2, range = 3;0-3;7), 60 10-year-olds (mean 10;1, range = 9;3-10;6), and 60 young adults. Preschoolers and forth-graders were recruited by letter correspondence with parents. Adults were college undergraduates who received course credit for participating. Equal numbers of females and males within each age group took part. Only native English language speakers were tested. Twenty-one 3-year-olds were dropped because of experimental error and three other three-year-olds were dropped because they failed to complete the procedure.

#### Materials

Generalization trials, for each of four events used in Experiment 1: Faufing, noffing, oushing, and smuking were selected for use in Experiment 2. Since there were three versions of each event, and four generalization trials per event, the total number of trials came to 48. These trials were selected because the pattern of generalizations varied least, both across events and within events across versions. Hence, an outcome change compared to a manner change (or any



other change) for one event had the same relative effect as the same combination for a different event as well as for different versions of the same event. It follows that any observed differences in generalizations obtained in Experiment 2, are not due exclusively to properties of the stimuli, but rather to differences in the training conditions.

### Procedure

Procedures paralleled those of Experiment 1 except that the type of training events differed and were shown in one of three conditions: Same, different, and constant plus noise. In the same condition, subjects were shown three versions of the same event. For example, manner training trials for faufing consisted of three virtually identical versions of faufing in which the manner (as well as the other three event components) did not vary. Manner training trials were virtually, though not completely identical because the actor was videotaped faufing in the same manner three different times. Events were filmed this way so that the training trials would simulate watching someone perform a novel action on three separate occasions, where very minor random variations in the action would occur. The same procedure was followed for every event with each of the remaining three event components. In the different condition, subjects viewed events in which only a single event component varied in each of the three training trials.

All the other event components were identical in the three training trials. For example, manner training trials for the faufing event consisted of three different manners in which faufing occurred. The same agent did the faufing, with the same instrument, which resulted in the same outcome in all three training trials.

The third condition, constant plus noise, comprised elements of the previous two conditions. Subjects in the constant plus noise condition saw three training trials in which a single event component was held constant while the other three event components varied slightly. For example, manner training trials consisted of three trials in which the manner of action was held constant across all three trials. The other three components were held constant across only two of the three trials. Thus a training sequence of three trials resulted in a subject viewing a single manner of action, two different agents, two different instruments, and two different outcomes. This same procedure was followed for agent, instrument, and outcome trials in the constant plus noise condition.

For each of the three conditions, all four events were used once as manner training trials. Agent, instrument, and outcome training trials were presented in the same way. Thus, each event was used equally often for agent, instrument, manner, and outcome training trials in each of

the three conditions. The order of training events was counterbalanced across subjects.

Training events were identified by the experimenter as follows: "Watch this," and "That was xing," said after the event had been viewed. Tomasello and Kruger (1992) found that unlike nouns, children demonstrated greater production and superior comprehension of novel verbs learned in non-ostensive (i.e., impending, completed) compared to ostensive (i.e., ongoing) contexts.

Generalization trials immediately followed the third training trial in all three conditions. The experimenter introduced half of the generalization trials by saying: "Was that xing, or was that something else?" For the remaining generalization trials the order of the query was reversed: "Was that something else, or was that xing?" Each subject was shown one generalization trial per set of three training events for a total of four generalization trials. The same four generalization trials were used in all three conditions. Generalization trials consisted of a different agent, manner, instrument, or outcome version of the training event. For example, manner training trials were followed by a manner generalization trial, instrument training trials by an instrument generalization trial, and so on. The order of training and generalization trials was counterbalanced across subjects.

Preschoolers were screened to establish whether were able to label simple familiar and unfamiliar actions seen on a video monitor and then say whether subsequent events were the same or something different (e.g., uncoupling a camcorder from a tripod followed by panning a cameraless tripod or uncoupling the camcorder again). All preschoolers performed the prescreening flawlessly.

## Results

### Generalizations

Generalizations were defined as the number of times subjects accepted a generalization trial as an example of a novel verb. Subjects could either accept or reject change type trial as an example of the novel verb. Thus the range of scores went from zero to one for any given change type within a single verb event. Table 4 gives the mean frequency of generalizations for individual change types, by condition and age. A high mean frequency for a given change type indicates that subjects were more likely to generalize the novel action verb. Conversely, a low mean frequency for a given change type indicates that subjects were less likely to generalize the novel action verb.

Table 4. Mean Number of Verb Generalizations (and Standard Deviations) by Age and Initial Experience Condition as a Function of Change Type.

Age	Change Type				Overall
	Agent	Instrument	Manner	Outcome	
Same					
3	0.69 (0.48)	0.15 (0.38)	0.38 (0.51)	0.15 (0.37)	0.35 (0.28)
10	0.85 (0.37)	0.55 (0.51)	0.20 (0.41)	0.05 (0.22)	0.41 (0.23)
Adult	0.95 (0.22)	0.60 (0.50)	0.10 (0.31)	0.20 (0.41)	0.46 (0.19)
Total	0.85 (0.36)	0.47 (0.50)	0.21 (0.41)	0.13 (0.34)	
Constant + Noise					
3	0.85 (0.38)	0.46 (0.52)	0.46 (0.52)	0.31 (0.48)	0.52 (0.31)
10	0.70 (0.47)	0.65 (0.48)	0.35 (0.48)	0.15 (0.36)	0.46 (0.25)
Adult	0.80 (0.41)	0.75 (0.44)	0.55 (0.51)	0.30 (0.47)	0.60 (0.24)
Total	0.77 (0.42)	0.64 (0.48)	0.45 (0.50)	0.24 (0.43)	

Table 4 continued.

Age	Change Type				Overall
	Agent	Instrument	Manner	Outcome	
	Different				
3	0.79 (0.43)	0.79 (0.43)	0.36 (0.49)	0.71 (0.46)	0.66 (0.25)
10	0.90 (0.30)	0.70 (0.47)	0.65 (0.48)	0.25 (0.44)	0.63 (0.21)
Adult	1.00 (0.00)	0.85 (0.36)	0.70 (0.47)	0.45 (0.51)	0.75 (0.16)
Total	0.91 (0.29)	0.78 (0.42)	0.59 (0.50)	0.44 (0.50)	

#### Initial Assumptions

The focus of Experiment 2 was on whether some elements of action verb meaning are more central to children's and adults' initial interpretations. The importance subjects accorded specific change type to their initial assumptions of verb meaning was inferred from the pattern of generalizations.

Generalizations were assessed using a 3 (Age: adult vs. 10-year-old vs. 3-year-old) x 3 (Initial Experience: same vs. constant + noise vs. different) x 4 (Component: agent

vs. manner vs. instrument vs. outcome) mixed analysis of variance with repeated measures on component. As predicted, all three main effects were significant. The kind of training events from which subjects learned the novel action verbs significantly affected how likely they were to generalize  $F(2, 151) = 17.48$   $p < .0001$ . A look at Table 4 shows that, overall, subjects in the different condition generalized most often; those in the same condition generalized least often. Table 4 also shows that generalizations by subjects in the constant plus noise condition were generally intermediate between those of the same and different conditions. The age of subjects significantly affected how likely they would generalize  $F(2, 151) = 3.58$   $p < .03$ . An inspection of the data summarized in Table 4 shows that children generally made fewer generalizations than adults. However, the mean number of generalizations made by 3-year-olds was not invariably lower than those made by adults or even 10-year-olds. Subjects' generalizations of the novel verbs were also significantly affected by the kind of change type  $F(3, 453) = 50.99$   $p < .0001$ . The data in Table 4 show that outcome and manner changes generally rendered subjects least likely to accept a change trial as an example of a novel verb.

#### Initial Experience Effects on Interpretation of Verb Meaning

Somewhat surprisingly, however, was that all three factors significantly interacted  $F(12, 453) = 1.91$   $p < .04$ .

A second objective of Experiment 2 was to find out whether young children's initial interpretations of action verbs differed systematically from those of adults. Of further interest was whether children's and adult's biased assumptions of novel action verb meaning could be altered by different types of verb learning experiences. Reinspection of Table 4 suggests that generalizations for instrument, manner, and outcome change types varied across the initial training conditions for 3-year-olds in a way that adults' and 10-year-olds' generalizations did not. Therefore, an reasonable strategy for analyzing the three-way interaction is to compare how the two-way interaction of change type and initial experience varies within each of the three different age groups.

More formally, initial experience significantly affected 3-year-olds' extensions of the novel verbs across the levels of change type,  $F(6, 111) = 2.46, p < .04$ . Tests for simple effects were next conducted within each of four different change types. For instrument,  $F(2, 37) = 6.85, p < .003$ ; and outcome changes,  $F(2, 37) = 5.78, p < .007$ , initial experience significantly affected 3-year-olds' generalizations. Initial experience had no significant effect on 3-year-olds' generalizations for agent or manner changes. These and all subsequent a posteriori comparisons were made using a Bonferonni adjustment to keep alpha at 0.05 per family of contrasts.



Of particular interest is precisely how initial experience affected 3-year-olds generalizations within the agent, instrument, manner, and outcome change types. Analysis of cell means within the instrument change type showed that initial experience had the predicted effects. Compared to the same condition, 3-year-olds in the different condition were significantly more likely to extend the novel verb  $F(1, 25) = 16.62, p < .0001$ . No further significant differences between cell means were observed for instrument changes. Contrasts of cell means within the outcome change type also showed initial experience had the predicted effects. Here, 3-year-olds generalized significantly more often in the different condition than in the same or constant plus noise condition:  $F(1, 25) = 11.63, p < .002$ ;  $F(1, 25) = 5.95, p < .01$ . Rather conspicuously, contrasts of cell means within the manner change type showed that initial experience did not have the predicted effects for 3-year-olds. Nor were any significant differences observed for contrasts of cell means within the agent change type. In sum, initial experience had the predicted effects on 3-year-olds generalizations only for selected change types: Instrument and outcome.

Visual inspection of Table 4 suggests that generalizations within each of the change types did not differ across the levels of initial experience for 10-year-olds and adults. Nonetheless, the appropriate statistical

analysis were undertaken to confirm this observation. These analyses showed that initial experience had no significant effects on 10-year-olds' or adults' extensions of the novel verbs across the levels of change type. Consequently, marginal means can be interpreted unambiguously for 10-year-olds and adults because the effects of initial experience do not significantly vary across the four different change types.

A priori contrasts of initial experience marginal means for 10-year-olds showed that the children were significantly more likely to extend the novel verb in the different compared to the same condition,  $F(1, 38) = 8.94, p < .005$ . Adults also generalized significantly more often in the different compared to the same condition,  $F(1, 38) = 27.09, p < .0001$ . No further significant differences between levels of initial experience were observed for 10-year-olds or adults.

A priori comparisons of change type marginal means revealed mostly similarities between generalizations made by 10-year-olds and adults. Both 10-year-olds and adults generalized significantly less often for outcome than agent;  $F(3, 57) = 43.81, p < .0001$  and  $F(3, 57) = 26.99, p < .0001$  respectively; or instrument changes;  $F(3, 57) = 11.63, p < .0001$  and  $F(3, 57) = 7.48, p < .0001$  respectively. Ten-year-olds and adults also extended the novel verbs significantly less often for manner than agent changes,  $F(3,$

57) = 15.12,  $p < .0001$  and  $F(3, 57) = 22.93$ ,  $p < .0001$ .

Where 10-year-olds and adults did very subtly differ was on how likely they were to generalize for manner compared to instrument and outcome changes. Ten-year-olds made significantly fewer outcome than manner generalizations,  $F(3, 57) = 5.12$ ,  $p < .003$ . Adults too made fewer outcome than manner generalizations, but the difference was not significant. For manner compared to instrument changes, adults generalized significantly less often to the former,  $F(3, 57) = 4.80$ ,  $p < .005$ . Ten-year-olds also made fewer manner than instrument generalizations, but the difference was not significant. These as well as all previous planned comparisons were made using the Bonferonni adjustment to keep familywise at 0.05.

Thus far the analysis shows that generalizations by 3-year-olds for manner changes differed from those of 10-year-olds and adults across the initial training conditions. The specific sources of the significant three-way interaction were as follows. For manner changes, 3-year-olds' generalizations did not significantly differ between the same and different conditions whereas 10-year-olds' and adults' did.

Additionally, the preceding analysis and an examination of the generalizations summarized in Table 4 suggest that the outcome and instrument changes were made comparatively more or less important for 3-year-olds simply by changing

the type of initial experience. On the other hand, for 10-year-olds and adults the comparative importance of change types did not vary within the three levels of initial experience.

This apparent change type by age interaction can be more closely examined by reanalyzing the significant three-way interaction in a slightly different way. The two-way interaction involving change type and age is analyzed within each level of initial experience. Change type and age did not significantly interact within the constant plus noise condition. Therefore, the main effects of initial experience, change type, and age can be interpreted unambiguously.

But within the different condition, change type and age did significantly interact,  $F(6, 153) = 2.53, p < .01$ . Tests for simple interactions showed that within the different condition, generalizations by 3-year-olds differed significantly from those by 10-year-olds,  $F(3, 96) = 4.50, p < .005$ ; and adults,  $F(3, 96) = 3.15, p < .01$ . A posteriori contrasts revealed only one significant comparison. Three-year-olds' generalized significantly more often for agent compared to manner changes in the different condition,  $F(1, 13) = 9.75, p < .008$ . Of greater interest was that unlike adults and 10-year-olds, 3-year-olds' outcome generalizations exceeded manner generalizations in the

different condition. However, the difference was not significant,  $F(1, 13) = 4.45, p < .055$ .

Within the same condition, change type and age also significantly interacted,  $F(6, 150) = 3.24, p < .005$ . Tests for simple effects showed that within the same condition, generalizations by 3-year-olds differed significantly from those by 10-year-olds,  $F(3, 93) = 3.94, p < .01$ ; and adults,  $F(3, 93) = 5.30, p < .002$ . A posteriori contrasts revealed two significant comparisons. Three-year-olds' generalized significantly more often for agent compared to instrument and outcome changes in the same condition:  $F(1, 12) = 14.00, p < .003$ ;  $F(1, 12) = 14.00, p < .003$ . Of greater interest was that unlike adults and 10-year-olds, 3-year-olds' manner generalizations exceeded instrument generalizations in the same condition.

More concisely, 3-year-olds' outcome generalizations exceeded their manner generalizations in the different condition. But in the same condition, 3-year-olds' manner generalizations exceeded their outcome generalizations. Similarly, in the same condition, 3-year-olds made fewer instrument than manner generalizations. But in the different condition, 3-year-olds instrument generalizations exceeded their manner generalizations. This pattern of generalizations contrasts markedly with that of adults and 10-year-olds. For both groups of the older subjects, the relative importance of individual change types did not

change within levels of initial experience. These results show that 3-year-olds' biased interpretation can be changed by the type of initial verb learning experience they receive. On the other hand, adults' and older children's biased interpretations of action verb meaning are relatively unaffected by the type of initial verb learning experience they receive.

### Discussion

In accord with Experiment 1, individual event components again had the predicted effects on subjects' generalizations. Overall, outcome changes had the greatest effect. Manner changes had the next greatest effect, followed by instrument, and agent changes. Given this pattern of generalizations, it would appear that the outcome component figured most prominently in children's and adults' initial assumptions about the meaning of novel action verbs. Previous research has also shown that some elements of meaning are more central than others to the initial representation of verbs similar to those used in the current study (Behrend, 1990; Forbes & Farrar, in press).

However, unlike previous research, the initial experience variable of Experiment 2 provides unique data on the relative strength of children's and adults biased interpretations of novel action verbs. The same condition was designed to maximize biased interpretations (e.g. outcome bias) subjects make when learning novel verbs. The

different condition was specifically designed to attenuate the same biases. The constant plus noise condition was designed to have an intermediate effect on subjects' interpretations.

Overall, these three conditions produced the hypothesized effects. In particular, when the initial training consisted of viewing three nearly identical events (i.e., the same condition), subjects were least likely to extend the novel verb. Outcome and manner changes tended to figure more prominently in 10-year-olds' and adults' initial interpretation of verb meaning. But outcome and instrument changes tended to figure more prominently in 3-year-olds' initial interpretation of verb meaning. When the initial training consisted of viewing three events in which a single event component varied (i.e., the different condition), subjects were most likely to extend the novel verb. Outcome and manner changes again tended to be more central to 10-year-olds' and adults' interpretation of verb meaning. For 3-year-olds, however, manner changes became the most central component in their initial assumptions about the meaning of the novel verbs. When the initial training consisted of viewing events in which only one component was held constant while the others varied (i.e., constant plus noise), subjects' made an intermediate number of extensions. In this condition, all subjects tended to favor the outcome component (i.e., make fewer generalizations).

These data show that children's and adults' preferences for specific event components can be enhanced or diminished simply by making them more or less prominent within the events from which the verbs are initially learned. Even more strikingly, the data show that unlike adults and 10-year-olds, 3-year-olds' biased interpretations of novel action verbs can actually be changed by different types of initial verb learning experiences. Apparently, verb learners are much less procrustean than a restrictive constraints perspective implies. Verb learners of all ages, and especially 3-year-olds, do not just blindly impose the same static set of one-size-fits all preferences and interpretations on action events of all types. Employing such a strategy, one could never hope to acquire the changing senses of the same verb, let alone the subtle differences among closely related verbs. Or as Nelson (1992) puts it:

A person's lexicon may contain much relevant information about the complexities of possible uses of particular word forms, but no given instance of the word can be perfectly predicted outside of its context of use, and the child must somehow use the situation to interpret what is meant in that context. A child who came to the language with highly constrained expectations about word meaning would be at a loss. (p. 5)

The most interesting finding from Experiment 2 was that the combined effects of initial training and change type varied according to subjects' age. Instrument, manner, and outcome changes affected 3-year-olds' generalizations across



the three levels of initial training in a way that did not happen for 10-year-olds and adults. One interpretation of this three-way interaction is that 3-year-olds learn action verbs differently than adults or even 10-year-olds.

When adults and 10-year-olds are "asked" (as in the same condition) which elements of action verb meaning are more central in their initial interpretations, they respond by generalizing least often to outcome and manner changes. When informed (as in the different condition) that an element of verb meaning can vary without changing the meaning of the verb, they generalize more often for all change types--but the relative importance of each verb component does not vary in their initial interpretations.

When the youngest subjects are "asked" which elements of action verb meaning are more central in their initial interpretations, they respond by generalizing least often to outcome and instrument changes. When informed that an element of verb meaning can vary without changing the meaning of the verb, they generalize accordingly--except for manner changes. In other words, the outcome and instrument bias 3-year-olds showed in the same condition completely disappeared in the different condition. Here, manner changes had the greatest effect on 3-year-olds's initial interpretations. In fact, 3-year-olds made a nearly identical number of manner generalizations in the same, constant plus noise, and different conditions. So for 3-

year-olds, initial experience had no effect on their initial assumptions about the importance of manner in the meaning of the novel verbs. But for the outcome and instrument components, initial experience significantly affected 3-year-olds initial assumptions.

The evidence argues against 3-year-olds merely making idiosyncratic interpretations of novel action verbs. Consider, agent changes for example. For all subjects, the same and different initial experience conditions had no effect on their initial assumptions about the importance of agent in the meaning of the novel verbs. Adults', 10-year-olds', and 3-year-olds' made virtually the same number of generalizations in both conditions. According to the principle AS, this is precisely what word learners are predicted to do: Extend novel action words to events in spite of changes of agent (Golinkoff, Jacquet, & Hirsh-Pasek, 1992). For instrument and outcome changes too, initial experience similarly affected generalizations by all subjects. Adults, 10-year-olds, and 3-year-olds made fewest generalizations in the same condition, most in the different condition, and an intermediate number in the constant plus noise condition. Only for manner changes, along with instrument and outcome changes in the different condition did 3-year-olds' generalizations systematically differ from those of older children and adults.

## CHAPTER 4 GENERAL DISCUSSION

Together, results from both experiments provide empirical data on the process of developing action verb concepts. Specifically, the studies support two conclusions. The first is that 3-year-olds' initial action concepts differ in a principled way from those of adults or even 10-year-olds.

Support for the first conclusion is found mainly in 3-year-olds' (a) manner generalizations across the levels of initial experience and (b) their outcome and instrument generalizations in the different condition. For 3-year-olds, all three initial experience conditions had the same effect on their extensions of the novel verbs for manner changes. Moreover, the relative importance 3-year-olds accorded outcome and instrument changes compared to manner changes was completely reversed in the different condition from what it had been in the same condition. On the other hand, for adults and 10-year-olds, the same and different conditions consistently had the predicted effects on their extensions of the novel verbs for all four change types. Overall, these subjects generalized more often in the different condition, less often in the same condition, and an intermediate number of times in the constant plus noise

condition. They also considered outcome and manner more central to action verb meaning than instrument and agent. Most notably, unlike 3-year-olds, the relative importance of individual change types did not change within levels of initial experience with either group of the older subjects.

The data show that the youngest children are not simply less likely than adults to extend novel verbs to events in which a single element of meaning has been changed. If 3-year-olds were just more conservative than adults, one would expect that the absolute number of generalizations for each of the four change types would be systematically lowest for 3-year-olds. But this did not always occur. For example, compared to adults, 3-year-olds did extend the novel verb less often for outcome changes in the same condition ( $\bar{M} = 0.09$  and  $\bar{M} = 0.20$  respectively). However, 3-year-olds also made more manner generalizations ( $\bar{M} = 0.36$ ) in the same condition than either 10-year-olds ( $\bar{M} = 0.20$ ) or adults ( $\bar{M} = 0.10$ ). The same condition of initial experience was specifically designed to reduce the likelihood of generalizations. So if 3-year-olds were plainly more conservative than adults, the evidence would have been found in the same condition for each of the four change types. A better explanation of the data is that 3-year-olds weighted the importance of manner, outcome, and instrument changes differently than adults and 10-year-olds.

Why were the youngest children's initial assumptions about the importance of manner changes nearly unaffected by the different types of initial experience? Perhaps 3-year-olds failed to notice the manner of action as much as they noticed the other three event components. Consequently, their interpretation of the novel verbs would have favored different semantic elements than adults' or 10-year-olds'. Compared to the other three components tested in the present studies, the manner component was more dynamic and transitory. Agent and instrument components were available for perceptual analysis before, during, as well as after the events were completed. Moreover, the events culminated in a particular outcome which continued to be perceptually available for brief inspection after the manner of action ceased to occur. This is not to suggest that the manner component is somehow more complex than the other components. Subjects of all ages probably had no difficulty in perceiving the manner of action. But even when shown, as in the different condition, that the manner of motion could change without affecting the meaning of the novel verb, 3-year-olds made the same number of generalizations as in the same condition.

If a failure to notice the manner component entirely accounted for the pattern of 3-year-olds' manner generalizations, then their manner generalizations should have been near ceiling (like their agent generalizations)

across all of the levels of initial experience. But this did not occur. A more likely explanation for why the importance of manner for 3-year-olds was unaffected by initial experience is that they are moderately biased to assume that manner is an important element of action verb meaning. Furthermore, this moderate manner bias is relatively impervious to the inconsistencies of initial action verb experiences.

The outcome bias observed in the present studies appears to be at odds with previous research showing a manner-over-end-state bias for very similar verbs (Bowerman, 1982; Gentner, 1978; Gropen, Pinker, Hollander, & Goldberg, 1991). Although for the younger children this outcome bias was eliminated by different types of initial experience. Unlike the present experiments or Behrend (1990), previous research showing a manner bias used familiar, rather than completely novel verbs. For this reason, even the youngest children (3-year-olds) probably had some previous experience with the kinds of events that verbs such as stirring and fill label. So rather than initial assumptions of novel action verbs, previous researchers more likely found intermediate assumptions. As an action event becomes familiar, the manner of action may become more central to the representation of that action concept.

This is what appears to have happened with adults' and 10-year-olds' generalizations for manner changes in the same

condition. Three repetitions of the same manner of action was sufficient to make 10-year-olds and especially adults more reluctant to accept a different manner for the event to occur. When subjects were shown three different manners in which the event could occur (i.e., different condition) adults and 10-year-olds rightly assumed that a particular manner of action was relatively unimportant to the verb's meaning. According to this reasoning, further training trials in the same and different conditions could make 3-year-olds generalizations for manner changes resemble those of adults and 10-year-olds.

A more serious criticism of previous research showing a robust manner bias concerns the line drawings Gropen et al. (1991) used to depict the verbs being studied. In effect, subjects were asked to recall (since familiar events were used) or imagine the appropriate manner of action to accomplish the event outcome. The one element of semantic meaning that using line drawings can not represent is the manner of action. To best represent manner of action, dynamic events such as those used in the current studies are best.

A reasonable strategy for resolving the discrepancy between previous research and the present studies would be to reexamine whether children show the same kinds of syntactic errors and a manner bias for novel events, rather than line drawings of known events such as those used by

Gropen et al. (1991). Using dynamic novel events rather than static pictures of familiar events may well result in an end state rather than manner bias. Whether children would still make syntactic errors is unclear given that the appropriate adult usage of the novel words would not be known. Nonetheless, it would be quite interesting to see the preferred syntactic constructions children generate with completely novel verbs.

The second conclusion clearly supported by the current studies is that verb learning is more like two sides of an equation than the restrictive constraints perspective implies. How children are equipped to interpret structured events, like novel actions, constitutes one side. The current studies indirectly examined children's general cognitive skills such as the representation and extension of specific (e.g., faufing) as well as more generalized action concepts (e.g., action verb). Clearly these and other skills such as the ability to acquire symbols and to integrate them into interrelated structures are essential for verb learning and lexical acquisition in general. But children's available conceptualizations and cognitive skills is but one side of the lexical acquisition equation. Very little is known about how children use the different sources of information available to them in verb learning situations. The present studies focused on how the context in which action verbs are learned affects verb learning,



which constitutes another side of the equation. This expanded view of lexical acquisition, encompassing both word learner and word learning situation, is precisely what an enabling constraints position advocates.

The overall point is that verb acquisition is inexplicable solely in terms of what children already know about verb meaning. Indeed, results from the present studies show that it is the adults and older children whose interpretations of novel verb meaning is relatively unaffected by different types of learning experiences. Young children's preferred interpretations of verb meaning appear to be much more tractable to experience. This suggests that children's biased interpretations of verb meaning arise more as a consequence of experience than of innately specified, language specific constraints on lexical acquisition. Information from sources such as those examined by the present studies do provide children with clues about the conventions of verb use.

## APPENDIX

Outline of all training and generalization events.

1. Blating: Place racquet ball on top of a table. Person whacks table with fists to make ball bounce up and down and hits ball with two articles of folded clothing to make it roll across the table and bounce off a wall.

A. Manner change: (a) Person kneels and pushes up from underneath table; (b) Person tilts table to and fro; (c) Person grabs back of table, lifts and lets it drop.

B. Instrument change: (a) Person whacks table with a monitor hanger; (b) Person whacks table with heavy stick; (c) Person whacks table with a book.

C. Outcome change: (a) Object remains stuck (on piece of poster tape) in place on table; (b) Object falls off side of table; (c) Object attached to a six inch tether so that it does not move very far.

D. Agent change: Three different people perform original event.

2. Noffing: Lay a tall, thin box on a table. Person inserts a fire extinguisher, drags the box backwards along the table, removes fire extinguisher, rights box, and then gives it a one quarter clockwise turn.

A. Manner change: (a) Rolls box; (b) Picks box up and carries it; (c) Upright box is pushed and made to revolve continuously.

B. Instrument change: (a) Camera tripod; (b) Log holder; (c) Stick inserted through box to which a bicycle tire liner is attached to form a yolk.

C. Outcome change: (a) Fire extinguisher left behind by abruptly pulling box out from underneath; (b) Fire extinguisher is placed in chair near the side of the table; (c) Fire extinguisher remains covered by box.

D. Agent change: Three different people perform original event.

3. Prebing: Press, using a the edge of a lamp base to cut log shaped piece of playdough into quarters.

A. Manner change: (a) Use a chopping motion; (b) Use a sawing motion; (c) Use a twisting and pulling motion.

B. Instrument change: (a) Bicycle brake cable; (b) Clear, round baking dish; (c) Piece of cardboard.

C. Outcome change: (a) Cut one quarter and then cut quarter into thirds; (b) Flatten the playdough; (c) Pile quarters on top of each other.

D. Agent change: Three different people perform original event.

4. Oushing: Box with holes punched out of bottom and filled with sugar used to drop sugar onto and cover a small red toy car.

A. Manner change: (a) Tip box over onto toy then remove it; (b) Lift box up over toy and pull it out from underneath sugar; (c) Lift box over toy and pour.

B. Instrument change: (a) Paper sack; (b) Piece of construction paper in the form of a snow cone with a hole in the bottom; (c) Glass juice container.

C. Outcome change: (a) Very small amount of salt comes out of box; (b) Sugar completely misses the toy; (c) Sugar comes out but there is no toy to cover.

D. Agent: Three different people perform original event.

5. Faufig: With a bicycle fixed cup remover (a kind of wrench), pick up two small filled plastic bottles and place them (without using attached ramp) on top of a small stool.

A. Manner change: (a) Underhand toss bottles into place; (b) Drag bottles into place up a ramp; (c) Launch bottles up ramp into place.

B. Instrument change: (a) Use hedge clippers; (b) Bicycle brake cable; (c) Large cup.

C. Outcome change: (a) Place bottles upright; (b) Place bottles half on stool and allow to fall to ground; (c) Drop bottle into sandbox under and in front of stool.

D. Agent change: Three different people perform original event.

6. Tulking: Loop two bicycle inner tubes around two cinder blocks and drag them backward along a brick fence (toward person) .

A. Manner change: (a) Pick up and carry (walking backward) cinder blocks; (b) Pick up blocks, pivot like a crane and pose blocks on fence; (c) Fling cinder block several times (without letting go of the inner tubes).

B. Instrument change: (a) Use a wooden frame; (b) Use a crow bar; (c) Throw a sack over the brick and drag it.

C. Outcome change: (a) Both blocks fall of end of fence; (b) One block drops off side of fence; (c) Blocks stacked end on end.

D. Agent change: Three different people perform original event.

7. Smuking: Stick three soda cans in horizontal line to large piece of gummed cardboard affixed to wall.

A. Manner change: (a) Bring cardboard down to cans; (b) Stick all three cans at once; (c) Bring cardboard halfway to can and can halfway to cardboard.

B. Instrument change: (a) Monkey puppet; (b) Magazine and stick; (c) Screwdriver and stick .

C. Outcome change: (a) Stick cans and replace on floor one at a time; (b) Place can on cardboard, but cans fall; (c) Place cans in triangle above cardboard.

D. Agent change: Three different people perform original event.

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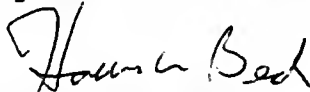
#### BIOGRAPHICAL SKETCH

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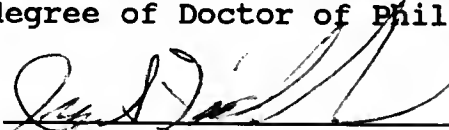
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M. Jeffrey Farrar, Chair  
Associate Professor Psychology

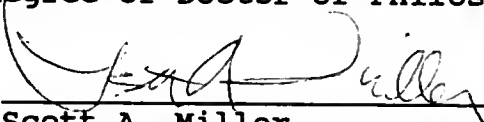
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Professor of Psychology

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